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BY

D. HARRINGTON AND C. W. OWINGS

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Mine Explosions in the United States During the Fiscal Year Ending June 30, 1929 [1]

By D. Harrington[2] and C. W. Owings[3]

The coal-mining industry of the United States finds difficulty not only in making ends meet financially but also in operating with anything like reasonable safety. The record to date has not been particularly good as to either finance or safety, but at least in some phases of safety there are indications of better times to come. During the fiscal year ending June 30, 1929, only 139 lives were lost in explosions in our mines as against 342 lost during the fiscal year ended June 30, 1928; this decrease in such fatalities is definitely a matter for satisfaction.

During the fiscal year July 1, 1928, to June 30, 1929, the attention of the safety division of the U. S. Bureau of Mines was directed to 38 mine explosions in the United States. Two explosions were in non-coal mines, one in a semianthracite mine, two in anthracite mines, and 33 in bituminous mines. These were not all major explosions - that is, explosions in which five or more lives were lost; in some of the explosions no lives were lost, while in others fewer than five fatalities resulted. Table 1 gives data on the explosions, showing the number of mines using open or closed lights and the number of explosions with resulting deaths, by causes, for each State.

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1 - The Bureau of Mines will welcome reprinting of this article provided the following footnote acknowledgment is used: "Reprinted from U. S. Bureau of Mines Information Circular 6178."

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Table 1. - Summary of mine explosions by States, July 1, 1928, to June 30, 1929

States	Lights			Total	Fatalities by ignition causes								Total	
	Open	Closed	Unknown		Electricity		Open light or smoking		Explosives		Unknown			
					Deaths	Ign.	Deaths	Ign.	Deaths	Ign.	Deaths	Ign.	Deaths	Ign.
Alabama ------	4	3	-	7	12	4	1	3	-	-	-	-	13	7
California----	1	-	-	1	-	-	0	1	-	-	-	-	0	1
Illinois -----	1	2	-	3	0	1	-	-	0	2	-	-	0	3
Kansas -------	1	-	-	1	2	1	-	-	-	-	-	-	2	1
Kentucky -----	2	-	1	3	-	-	3	1	2	1	6	1	11	3
Ohio ---------	3	-	-	3	-	-	1	2	2	1	-	-	3	3
Oklahoma -----	-	1	-	1	1	1	-	-	-	-	-	-	1	1
Pennsylvania -	1	8	-	9	65	7	3	1	2	1	-	-	70	9
Utah ---------	-	2	-	2	1	1	-	-	0	1	-	-	1	2
Virginia -----	-	1	-	1	2	1	-	-	-	-	-	-	2	1
West Virginia	5	2	-	7	10	2	6	3	20	2	-	-	36	7
Total fiscal year ending June 30, 1929	18	19	1	38	93	18	14	11	26	8	6	1	139	38
Total fiscal year ending June 30, 1928 1/	14	15	2	31	282	14	49	12	9	3	2	2	342	31

1/ See Information Circular 6085, issued October 28, 1928.

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Pennsylvania, with nine explosions, heads the list; Alabama and West Virginia with seven each are second; and Illinois, Kentucky, and Ohio are third with three each. Of the 38 explosions, 18 were in open-light mines, 19 in closed-light mines, and in one mine the lighting was unknown, but from circumstances surrounding the explosion it is strongly suspected that open lights were used.

Sixteen of the 18 explosions reported to have been of electrical origin were in closed-light mines, and all but two of the 93 fatalities in this group were in the closed-light mines; one gas ignition in an open-light mine did not result in any fatalities and one gas ignition in another open light (metal) mine resulted in two fatalities. The assigned causes of the ignitions by electricity are given in Table 2, following:

Table 2. - Electrical causes of explosions

Cause	No. of ignitions
Nonpermissible mining machine 1/	5
Trolley locomotive 2/	5
Nonpermissible motor	4
Faulty wiring	2
Trolley wire 3/	1
Nonpermissible storage-battery locomotive	1
Electric arc	2
Total number	20

1/ Possibly smoking in one case.
2/ May have been open light in one case.
3/ Explosives car ran into trolley wire which previously had been partly knocked off some of the hangers.

Nonpermissible mining machines and locomotives of the trolley type were the most prolific cause of electrical ignitions; five explosions undoubtedly were initiated by each cause, although one explosion attributed to mining machines may possibly have been caused by an open light. One explosion attributed to faulty wiring was alleged to have been caused by an arc from the lead wire connected to a Cardox cartridge, the other end of the wire having been connected to a

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trolley wire, contrary to the conditions under which the Cardox system of blasting is now given Bureau of Mines' permissibility. Nonpermissible electric motors caused four ignitions and a nonpermissible storage-battery locomotive caused one. All of the explosions in closed-light mines were caused by nonpermissible electrical equipment. Permissible lights exclusively should be used in every coal mine in the United States, but it is folly to try to overcome the mine explosion hazard by adopting closed lights and at the same time requiring or allowing the men to work with or around open-type electrical mining machines, drilling machines, locomotives, motors, rock-dusting machines, etc., or in the presence of bare conductors of electricity. From the facts developed as to explosions initiated during each of the past 10 or more years it would appear that the time has come when all mine operators, especially those who recognize the gas hazard by installing permissible lights, should cease pretending to a condition of safety because they have merely installed closed lights; instead of relaxing vigilance after equipping the mine with permissible lights, true safety should further be secured by the installation and careful use of permissible electrical machinery and by the most rigid safety practices as to ventilation, dust prevention, and dust dissemination.

Open lights or smoking caused 11 explosions resulting in 14 deaths. The majority of these accidents were in so-called nongassy mines. Through the continued use of open lights the men were led to believe that gas was not to be found in the mines, although gas could be detected in at least some instances, and in each ignition gas was the initiating agent. Nearly all thoughtful coal mining men now recognize that all coal mines are potentially gassy, realizing that at all times, even in so-called nongassy mines, a body of gas may be liberated by a roof fall or other means or that a dangerous accumulation of gas may be caused by some unforseen ventilation interruption. Where open lights are permitted, those who go underground often become careless; frequently where supposedly small pockets of gas collect, miners or mine officials deliberately ignite the gas. One means of overcoming this hazard, as well as numerous others of similar nature, is the exclusive use of closed lights and the exercise of continued or preferably increased vigilence in connection with ventilation and with installation and use of electricity.

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Of the eight explosions attributed to explosives, four were caused by blasting with mud-capped shots; the ensuing explosions caused 22 deaths out of a total of 26 from explosives. Firing of mud-capped shots in coal mines is inexcusable, and there are no extenuating circumstances for this reprehensible practice; it is wasteful of explosive and is inefficient, little or no time is saved, and there is likelihood that considerable damage and possible loss of life will be caused by this method of blasting. There is a suitable grade of permissible explosive for every blasting operation; however, to retain its permissibility any permissible explosive must be properly confined in a hole, properly stemmed, and detonated electrically. Many mines in which permissible explosive is used in a proper manner for general blasting break large pieces of rock by firing mud-capped shots; the results are often disastrous.

One explosion listed as resulting from an unknown cause is strongly suspected of having resulted from either open lights or an arc from a mining machine; under the conditions found after the explosion it was possible for either cause to have been responsible for the ignition; electrical origin, however, appears to be the most likely.

Rock-dust had been applied to a limited extent in 13 of the 38 mines, and in 6 of these 13 mines there is no doubt that rock-dust played an important part in limiting the explosion. In these six mines 62 lives were lost, whereas 470 men were exposed to the explosions and many of them might have lost their lives if rock-dust had not been applied. In one mine rock-dust had been applied in the explosion area the night before the disaster occurred, and it undoubtedly stopped propagation of the flame; four men at the point of origin were killed, but there is very good reason for the belief that some or all of the other 58 lives were saved through the effectiveness of the rock-dusting. It is entirely probable that many of the 62 lives lost in the mines using rock-dust would have been saved if effective rock-dusting had been practiced. In most of these partly or imperfectly rock-dusted mines the explosion traveled through unprotected rooms, crosscuts or the trackless entries where only too many mining men think that rock-dusting is unnecessary. To be effective, rock-dust must be applied to all rooms, crosscuts, and entries to within at least 40 feet of the face as well as to all other accessible open surfaces; the incombustible content must generally be 65 per cent or more if no gas is present, with correspondingly greater percentages of incombustible with increasing percentages of methane in the surrounding air.

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It is of interest to note the time of day at which the explosions took place, as indicated in Table 3.

Table 3. - Time of day explosion occurred

Time, a.m.	No. of explosions	Time, p.m.	No. of explosions
12 to 1	0	12 to 1	2
1 to 2	2	1 to 2	0
2 to 3	0	2 to 3	3
3 to 4	0	3 to 4	3
4 to 5	0	4 to 5	2
5 to 6	3	5 to 6	1
6 to 7	2	6 to 7	1
7 to 8	4	7 to 8	2
8 to 9	2	8 to 9	3
9 to 10	0	9 to 10	0
10 to 11	2	10 to 11	1
11 to 12	4	11 to 12	0

Although the number of explosions listed is not large and no definite conclusions may be drawn, it is indicated that the most likely periods in which disasters now occur is from 5 to 9 o'clock in the morning when the men are going to work and shortly after work is begun or supposed to have begun. Near the noon hour, 10 to 1 o'clock, is another period in which explosions most frequently occur; finally, explosions are likely to take place when the men are leaving the mine on the day shift and the night-shift men begin to arrive or start to work, from 2 to 9 o'clock in the afternoon and evening.

An obvious interpretation of the above tabulation is that the time of occurrence of this type of accident points directly to carelessness as the cause. In the morning the worker's mind evidently is slow to settle to the task in hand, and on the way to his working place safety is given second or third or even more remote consideration; in the rush to start work, electrical machinery in need of repair is taken out before the repair man has an opportunity to work on it; the workman upon entering his place frequently sits down for a rest and is likely to take a smoke (even where smoking is forbidden) and ignite gas at the face of his working place; or a workman hurrying to remove a fall of roof, in

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order to start loading coal at the working place, may fire a mud-capped shot to break a large piece of rock. Frequently an accumulation of methane is ignited at or near the face practically as soon as the worker reaches the face to begin his shift, and only too often this is due to faulty examination or to lack of examination by the fire boss for presence of explosive gas. Again, at lunch hour attention is taken from work, and carelessness, manifest in numerous ways, may result in infraction of safety rules with disastrous results. In short, whenever attention is not wholly on work and on safety the worker is likely to take a chance and an explosion is likely to occur as a result of certain types of carelessness in almost any coal mine.

The months in which the explosions occurred are given in Table 4.

Table 4. - Months in which explosions occurred.

Month, 1928	Number of explosions	Month, 1929	Number of explosions
July	3	Jan.	8
Aug.	8	Feb.	3
Sept.	1	March	4
Oct.	2	April	0
Nov.	2	May	3
Dec.	1	June	1

January and August had eight explosions each, the greatest number in any one month; March was the second with a total of four explosions; February, July, and May ranked third with three each; and April was the only month in which no explosions occurred. Evidently, the month of the year does not seriously affect the liability to explosions, for the first six months of 1928 show a different ratio from the same period in 1929, the explosions by month in 1928 being January 1,; Feburary, 3; March, 0; April, 4; May, 4; June, 2.

Table 5 lists in the fiscal year ending June 30, 1929, 38 explosions as against 31 in the fiscal year ending June 30, 1928; this does not necessarily mean that there were actually a greater number of mine explosions during the past fiscal year than in the previous one, but it does indicate that attention of the Bureau of Mines was called

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to 38 such affairs during the past year and to but 31 in the previous year. This table shows that 18 out of the 38 explosions, or 47.4 per cent, were started by electricity, as compared with 14 out of 31, or 45.1 per cent, explosions of electrical origin during the previous fiscal year. It is certainly significant that nearly half (32 out of 69) of the explosions in our mines during the past two fiscal years were started by electricity.

Open lights were responsible for 11 out of the 38 explosions, or 29 per cent, during the fiscal year ending June 30, 1929, as against 12 out of 31 (38.7 per cent) in the previous fiscal year; the explosions starting from open lights are diminishing as the progressive mines of the country take up the use of the safer and more efficient permissible electric cap lamps.

In the past fiscal year 8 explosions out of 38, or 21 per cent, were started by explosives as against 3 out of 31 (9.7 per cent) in the previous year; as heretofore indicated, much of this increase in number of mine explosions started by explosives has been due to the reprehensible practice of using mud-capped shots.

Table 5. - Comparison of explosion ignition causes, fiscal years 1927-28 and 1928-29

Years	Electricity		Open lights or smoking		Explosives		Unknown		Total	
	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Per cent
1927 - 28	14	45.1	12	38.7	3	9.7	2	6.5	31	100.0
1928 - 29	18	47.4	11	29.0	8	21.0	1	2.6	38	100.0

Table 6 has information of a similar nature to that given in Table 5, but it deals with loss of life rather than number of explosions by ignition causes in the past two fiscal years. Only 139 lives were known to have been lost in mine explosions in the United States during the fiscal year ending June 30, 1929, as against 342 in the previous fiscal year; this is certainly gratifying. Electrical ignitions caused explosions with resultant loss of 93 lives out of a total of 139 for the year, or 66.9 per cent; during the previous fiscal year 282 lives

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were lost through explosions of electrical origin out of a total of 342, or 82.5 per cent. Our mining people should certainly ponder over the fact that during the past year much more than half of the fatalities from explosions in our mines came from electrical ignitions and that during the previous fiscal year more than three-quarters of the fatalities from mine explosions came from electrical ignitions. Surely there should be much greater care exercised in usage of electricity in our mines.

Table 6. - Comparison of explosion fatalities by ignition causes, fiscal years 1927-28 and 1928-29

	Electricity		Open lights		Explosives		Unknown		Total	
	No. killed	Per cent	No. killed	Per cent	No. killed	Per cent	No. killed	Per cent	No. killed	Per cent
1927-28	282	82.5	49	14.3	9	2.6	2	0.6	342	100.0
1928-29	93	66.9	14	10.1	26	18.7	6	4.3	139	100.0

There were but14 fatalities (10.1 per cent) from explosions originating from the use of open lights in our mines in the past fiscal year as against 49 fatalities (14.3 per cent) of the total during the previous fiscal year. It is probable that the past fiscal year shows the smallest number of fatalities from open-light ignitions starting mine explosions for any one year in the history of mining in the United States. This is another decidedly good sign of progress.

Twenty-six fatalities (18.7 per cent) were caused by explosions in mines due to explosives; this is by no means as favorable as the previous year's record of nine killed with but 2.6 per cent of the total from the same cause. This relatively poor record of last year as to fatalities from explosions caused by explosives might have been very much worse, as there were at least two mine explosions during the year which started at blasting time and resulted in heavy property damage but no loss of life, due to use of the method of doing all blasting from the surface with all persons out of the mine.

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There was one explosion with loss of 6 lives of which the cause was not definitely determined; hence this disaster is listed in the unknown column, though it is probable that this explosion with its loss of 6 lives should be added to those listed as of electrical origin.

Table 7. - Comparison of lighting in mines where explosions occurred, fiscal years 1927-28 and 1928-29

	Open lights		Closed lights		Lighting unknown		Total	
	No.	Percent	No.	Percent	No.	Percent	No.	Per cent
1927-28	14	45.1	15	48.4	2	6.5	31	100.0
1928-29	17	47.4	19	50.0	1	2.6	38	100.0

Table 7 gives data for the past two fiscal years as to the number of explosions in closed-light mines as against those in open-light mines. There were 19 of the 38 explosions (50 per cent) of the past fiscal year in closed-light mines, as against 15 out of 31 (48.4 per cent) during the previous fiscal year; 18 (47.4 per cent) of the past year's explosions were in open-light mines and 2 of these were noncoal mines.

The 18 explosions in open-light mines during the past fiscal year caused 43 fatalities, while the fatality list of 19 explosions in closed-light mines was 92. There is no doubt that the explosions now started in closed-light mines generally have a much stronger "kick" than those in open-light mines, due probably to the fact that with use of closed lights there is more likelihood than with open lights of getting

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comparatively large accumulation of methane at or near a working face and practically all of the gassy mines are closed light, therefore these mines are potentially more hazardous than the open light mines; if open lights are in use, the open flame is likely to ignite the accumulating gas before it can gather in large quantities; the open light, however, has so many hazards as to gas or dust or explosive ignitions causing fires or explosions in mines, that common sense should outlaw any open flame from any kind of mine workings. There is no question that while the use of closed lights, especially those of the permissible type and more especially the permissible electric cap lamp, eliminates many of the hazards of possible mine fires or mine explosions, on the other hand explosions and fires can be expected to continue to occur as long as coal-mining people install this safe lighting system in some mines and refuse to install it in others (fully half of our coal mines continue to use open lights). Also, as long as coal-mining companies install closed lights and allow (openly or otherwise) underground smoking, use of fuse, squibs, black blasting powder, or open types of electrical machinery, or as long as they refuse to rock-dust, or continue to rock-dust in the desultory, half-hearted manner, in which most of our rock-dusting is done, widespread explosions in coal mines are certain to continue to occur.

More than 90 per cent of the explosions in our closed-light mines are due to unsafe electrical installations or to unsafe use of electricity, and there appears to be definite ground for the accusation that many mining companies are using the closed lights in an attempt to offset the installation of the cheaper and much more dangerous nonpermissible electrical equipment rather than using the much safer and more rugged permissible equipment; there also appears to be foundation for the belief that in many instances there is definite relaxation in maintenance of ventilation installations and practices after closed lights have been installed; this relaxation is responsible for attempting ventilation by such makeshifts as electrically driven auxiliary fans and tubing, with consequent "savings" due to decreased use of brattice cloth; instead of erecting reasonably strong incombustible stoppings, frequently flimsy canvas, brattice cloth, board or gob stoppings, board overcasts, regulators, etc., are found in definitely gassy mines; instead of having well-defined splits, continuous coursing of air is found; instead of diverting or coursing air by means of well-constructed overcasts, regulators, etc., frequently dependence is placed on the flimsiest of brattice curtains or on single doors or combination of these; instead of securely sealing abandoned caved regions they are held open, with a pretense of ventilating them;

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air courses are allowed to become so badly clogged by falls, water, and other restrictions that air circulation through these places gradually becomes practically an impossibility, and this condition in some mines has become so bad as to require abandonment of the mine after the occurrence of the usual one or more explosions. This list of delinquencies in ventilation found in connection with installation of closed lights could be extended and specific instances given. There is absolutely no justification for these ventilation relaxations in closed-light mines, but so long as they continue, 50 per cent, or more than 50 per cent of our explosions will also continue to occur in closed-light mines.

After one mine explosion, the state inspector made the following report: "Visited this heading at 10:[illegible] and found four crosscuts open. Made flame safety lamp examination and found gas in an explosive mixture. Ordered all men to cease work until brattices were put in and places well watered. Left expecting my orders to be complied with. Instead section foreman ordered men to return to work. My conclusion is that an electric arc ignited this gas. It would appear that the management is partially depending on the electric cap lamps for protection which is false security. General carelessness in dealing with ventilation is in evidence."

In fact, explosions will continue to occur in our mines as long as our mining men continue to try to "get by" with the adoption of as few as possible of the precautionary measures which better experience demands should be used, and then upon occurrence of a disaster adopt these measures one or two at a time; practically always the person in charge leaves out a number of the really essential measures which seem to him not definitely applicable to some particular mine or mines, but which, as a matter of fact, should be used if the mines are to be safely operated.

Some of the surrounding conditions under which a comparatively small number of the explosions during the past fiscal year occurred are briefly indicated, as follows: One explosion was caused by gas ignition upon operating an open-type electric switch at a charging panel for a permissible storage-battery locomotive; one gas ignition was due to an arc from a cable-reel locomotive on a "hill" not far from the face of an advancing entry; another gas ignition was from a nonpermissible electric motor operating an air compressor; an open-type electric motor on a rock-dusting machine caused at least one ignition (this is a comparatively new hazard introduced with the extension of rock-dusting and

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in this case apparently the mine fan had not been in operation); a gas ignition was also caused by a defective enclosed-type (not permissible) electric cutting machine; in one place where a trolley locomotive was hauling a man trip there was a gas ignition from the trolley arc; in one mine a gas ignition occurred from an open-type electric mining machine where the services of the fire boss had been dispensed with as a matter of economy. A trolley locomotive was run into a place which had not been examined by a fire boss and a gas explosion occurred; the breaking of an ordinary electric-light globe ignited the gas in one mine; the wrecking of electric-light wires ignited coal-dust in another mine; there were at least two (probable more than two) gas ignitions by electric hoist motors of gas accumulations due to poor ventilation conditions from use of auxiliary fans. In one case a mining machine operator moved a ventilation curtain and a gas ignition soon occurred; there was at least one instance of the old-time gas ignition by fire boss with open light on his cap and flame safety lamp in his hand. In several instances after open-light ignitions, the mine was put on a closed-light basis, and there were at least two (possibly several more) cases of gas ignitions from smoking in closed-light mines. At least two bad explosions occurred from mud-capped shots; this very poor practice claims its victims in several instances every year. At least two explosions were said to be due to shooting (probably in presence of methane both times) heavily over-loaded shots of permissible explosive; in one mine where a comparatively violent explosion occurred at blasting time, it was very definitely stopped by rock-dust; in another mine, where accumulation of methane was ignited by a nonpermissible storage-battery locomotive, the resultant explosion was stopped "dead" by rock-dusting which fortunately had been done on the preceding night.

CONCLUSIONS

1. Mine explosions continue to occur, and it seems that they are occurring with increasing regularity and in increasing number, though fortunately there was a very gratifying decrease in fatalities in the past fiscal year as compared with the previous one.

2. The ignitions which caused the explosions were caused by electricity, by open lights or smoking, and by explosives. Electricity caused 13 explosions and 93 deaths; open lights or smoking caused 11 explosions resulting in 14 fatalities; explosives caused 8 explosions which took 26 lives; and one explosion, in which 6 lives were lost,

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was caused either by open lights or by an electric arc or spark.

3. During the fiscal year ending June 30, 1929, more explosions occurred in closed-light mines than in open-light mines, 19 taking place in closed light mines and 18 in the open light mines. Closed-light mines are mostly gassy; the ease with which an explosion may start in them is greater than in most of the open-light mines, hence nearly all, though not absolutely all, explosions caused by electricity are at present in the closed-light mines. With but 14 lives lost through explosions started by open lights, this is by far the best record for open lights in the history of mining in the United States for at least 50 years.

4. It is a fallacy to expect to eliminate the explosion hazard by introducing closed lights into a mine and at the same time continuing the operation of open-type electrical equipment. All coal mines (and preferably all mines) should use only permissible lights; and in every closed-light coal mine only permissible equipment should be used and the permissible equipment should be kept in permissible condition by being maintained in a good state of repair at all times.

5. Only permissible explosives should be used in coal mines, and firing of mud-capped shots should be prohibited in all coal mines. Also all blasting in coal mines should be done by carefully controlled electrical means.

6. Rock-dust was used at least in part of 13 of the 38 mines in which explosions occurred, and in 6 of the mines rock-dust played an important part in stopping the propagation of the explosion; it is fair to assume that if rock-dusting had not been done in these mines, instead of the 62 deaths which actually occurred a considerable percentage (possibly all) of the 428 who escaped would have been killed.

The effectiveness of the rock-dusting was doubtful in seven other mines using this method of protection, as only parts of the mine and usually only one entry in each set of two or more entries was treated with rock-dust; it is probable that in these seven mines rock-dusting had no influence on the explosion. To be effective all open accessible parts of a mine must be dusted to within at least 40 feet of every working face, and all nonworking but accessible places should be kept well rock-dusted throughout.

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7. The explosions occurred most frequently between the hours of 5 to 9 a.m.; 10 a.m. to 1 p.m.; and 2 to 9 p.m. As these are the hours when shifts are changing, the indication is that undoubtedly there is much carelessness at such times so that the likelihood of having an explosion is greatest then.

8. The greatest number of explosions occurred during January and August; in each of these months eight explosions took place; the period of time over which these records extends, however, does not admit of drawing conclusions as to the periods of the year at which explosions are most likely to occur.

9. At least 18 explosions, with 93 deaths, were caused directly by various types of mechanical appliances used in mines, and it is probable that several of the other 30 explosions causing considerable loss of life were at least indirectly attributable to use of machinery in mines. This indicates that in addition to causing annually a large number of both fatal and nonfatal accidents by contacts of various kinds in our mines, mechanical appliances are also responsible for a considerable number of explosions with a relatively large number of resultant fatal and nonfatal accidents, as well as destruction of much property. This situation would appear to demand that much additional precaution should be taken in our mines in connection with use of machinery of various kinds, and this need becomes more acute day by day as mine mechanization is extended.

10. Mine explosions are the least excusable of the accidents which occur in or around mines, but they will continue to occur as long as mining men continue to select a few of the known precautions against explosions and reject the others. While there are few if any mines which now use all the necessary and readily available precautions against explosions, there are practically none which can not and should not use all of these precautions. Explosions are going to occur as long as mining men continue to insist on using selectivity as to precautionary measures toward prevention of explosions, rather than wholeheartedly committing themselves to safety and using all of them.

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